

**THAT WHICH IS CLAIMED IS:**

1. A sensor for detecting a presence of food borne bacteria, the sensor comprising:
  - a housing having a bore fully extending therethrough;
  - a pH sensitive material including a pH indicator for providing a visual color change responsive to an increased level of carbon dioxide gas above an ambient level thereof, the pH sensitive material carried within the bore and having opposing first and second surfaces exposed to an environment about the housing; and
  - a fastener carried by the housing for removably placing the opposing first and second surfaces of the material in a spaced relation to an adjoining surface, thus permitting a free movement of the carbon dioxide gas thereabout and direct diffusion of the carbon dioxide gas onto and through the opposing first and second surfaces of the pH sensitive material.
2. A sensor according to claim 1, wherein a color change from green to orange results from the increased level of carbon dioxide gas diffusing through the pH sensitive material for reducing a hydrogen ion concentration and thus reducing the pH.
3. A sensor according to claim 2, wherein the pH sensitive material comprises a mixture of Bromothymol Blue and Methyl Orange.
4. A sensor according to claim 1, wherein the pH sensitive material comprises a gel.
5. A sensor according to claim 4, wherein the gel comprises agar.

6. A sensor according to claim 5, wherein the agar is encapsulated within at least one of a permeable silicone, TPX, TPU, and PFA cover.

7. A sensor according to claim 1, wherein the pH sensitive material comprises an antifreeze agent.

8. A sensor according to claim 7, wherein the antifreeze agent comprises at least one of ethylene glycol and glycerol for preventing a freezing of any water component below 0°C.

9. A sensor according to claim 1, wherein the pH sensitive material comprises first and second material portions extending between the opposing first and second surfaces, the first material portion comprising a buffered pH indicator having a reference color, the second material portion having the reference color at an initial pH level and changing to a warning color at a predetermined pH level, the warning color visually contrasting the reference color.

10. A sensor according to claim 1, wherein a ratio of a thickness dimension to an effective width dimension of the pH sensitive material is in a range of values from 0.003 to 0.03.

11. A sensor according to claim 1, wherein the pH of the material ranges from 7 - 10 in the ambient level carbon dioxide gas environment.

12. A sensor according to claim 1, further comprising first and second gas permeable covers respectively enclosing the pH sensitive material and thus the opposing first and second surfaces within the bore, the permeable covers permitting the diffusion of the carbon dioxide gas therethrough.

13. A sensor according to claim 12, wherein the first and second covers comprise gas permeable membranes.

14. A sensor according to claim 12, wherein the gas permeable covers comprise a gas impermeable material having a plurality of holes extending therethrough.

15. A sensor according to claim 14, wherein the holes form a descriptive pattern representing a state of the pH sensitive material.

16. A sensor according to claim 15, wherein the cover comprises a predetermined color indicative of a pH level for the pH sensitive material.

17. A sensor according to claim 1, wherein the housing comprises a color representative of an initial color for the pH sensitive material.

18. A sensor according to claim 17, wherein the housing comprises a green color representative of the initial color, and wherein a color change from the green color to an orange color results from the increased level of carbon dioxide gas.

19. A sensor according to claim 18, wherein the pH sensitive material comprises a mixture of bromothymol blue and methyl orange.

20. A sensor according to claim 1, wherein the pH sensitive material is formed from an edible material and an edible pH indicator.

21. A sensor according to claim 20, wherein the edible pH indicator is formed from a food extract.

22. A sensor according to claim 21, wherein the food extract is processed from a food group consisting of cabbage, grapes, onions, berries, flowers, plums, and cherries.
23. A sensor according to claim 20, wherein the edible pH indicator comprises at least one of glucose and sucrose for reducing a rate of oxidation and breakdown thereof.
24. A sensor according to claim 20, wherein the edible pH indicator changes color within a predetermined time period regardless of bacterial growth and freshness of the food product.
25. A sensor according to claim 1, wherein the housing comprises a handle portion and a sensor portion, the sensor portion having the bore therein.
26. A sensor according to claim 25, wherein the fastener comprises a tapered portion formed within the handle portion for piercing a food product.
27. A sensor according to claim 1, wherein the fastener comprises an adhesive material carried thereby.
28. A sensor according to claim 27, wherein the adhesive material comprises Velcro.
29. A sensor according to claim 1, wherein the fastener comprises a pin carried by the housing for piercing a structure, wherein the structure includes at least one of a food product and a package.
30. A sensor according to claim 1, further comprising a container for carrying a food product therein, wherein the first and second surfaces of the

pH sensitive material is carried within the container by the housing in a spaced relation to the food product and surfaces of the container.

31. A sensor according to claim 30, wherein the pH sensitive material is carried only within a lower one-half portion of the container.
32. A sensor for detecting a presence of bacteria in a perishable food product, the sensor comprising:
  - a housing having a bore extending fully therethrough;
  - a gas-permeable material carried within the bore so as to expose at least two opposing surfaces; and
  - a pH indicator carried by the gas-permeable material for detecting a change in a gaseous bacterial metabolite concentration indicative of bacterial growth, wherein a pH change results from the presence of the metabolite.
33. A sensor according to claim 32, further comprising a container dimensioned for receiving the perishable food product and the housing therein.
34. A sensor according to claim 32, wherein the pH indicator is responsive to an alkaline gas.
35. A sensor according to claim 34, wherein the alkaline gas comprises ammonia resulting from a protein breakdown of the food product.
36. A sensor according to claim 32, wherein the pH indicator is responsive to an acidic gas.
37. A sensor according to claim 36, wherein the acidic gas comprises carbon dioxide resulting from bacterial growth in the food product.

38. The sensor according to Claim 32, wherein the pH indicator is adapted to exhibit a radiative change selected from a group consisting of absorbance, fluorescence, and luminescence.

39. The sensor according to Claim 38, wherein the pH indicator undergoes a color change commensurate with the pH change.

40. The sensor according to Claim 39, further comprising a reference color carried proximate the pH indicator for use in comparing the color change thereto.

41. The sensor according to Claim 40, wherein a warning icon is formed by the color change.

42. The sensor according to Claim 32, wherein the housing is temporarily attached to an interior of the container.

43. The sensor according to Claim 32, wherein the pH indicator comprises an aqueous pH indicator, and wherein the housing further includes first and second gas permeable covers operable with the bore for securing the aqueous pH indicator therein.

44. The sensor according to Claim 43, wherein the first and second covers are impermeable to charged particles.

45. The sensor according to claim 44, wherein the covers comprise a film material selected from a group consisting of TPX, PFA, and TPU film

46. The sensor according to Claim 32, wherein the gas permeable material comprises a substantially transparent silicone, and the pH indicator comprises an aqueous pH indicator encapsulated within the silicone.

47. The sensor according to Claim 32, wherein the gas permeable material comprises a substantially transparent agar and the pH indicator comprises an aqueous pH indicator cured in a mixture with the agar.

48. The sensor according to claim 32, wherein the pH indicator comprises one of bromothymol blue, phenol red, and cresol red, the pH indicator having an initial color indicating an alkaline initial pH, the indicator turning a second color upon experiencing a decrease in pH.

49. The sensor according to claim 32, wherein the pH indicator comprises a mixture of bromothymol blue and methyl orange, the indicator having a green color indicating an initial alkaline pH of 7.2, the pH indicator turning an orange color upon experiencing a decrease in pH.

50. The sensor according to claim 32, wherein the housing is positioned within the container for placing the gas-permeable material in a spaced relation to interior walls thereof such that gas has access to both sides of the gas-permeable material thus permitting faster gas diffusion therethrough and a faster response time to a color change in the pH indicator.

51. The sensor according to claim 32, wherein at least a portion of the pH indicator is adapted to undergo a substantially irreversible change of state upon detecting the metabolite concentration change.

52. A sensor for detecting a presence of food borne bacteria, the sensor comprising:

a housing having a bore fully extending therethrough; and  
a carbon dioxide indicator positioned within the bore for detecting bacterial growth, the indicator comprising an aqueous solution including calcium hydroxide, an infusion of carbon dioxide into the housing effecting a

detectable calcium carbonate precipitate, wherein the indicator is exposed to an environment from opposing first and second ends of the bore.

53. A sensor according to claim 52, further comprising a fastener carried by the housing for placing the opposing first and second ends of the bore in a spaced relation to an adjoining surface, thus permitting a free movement of the carbon dioxide gas thereabout and direct diffusion of the carbon dioxide gas onto and through the carbon dioxide indicator.

54. A sensor according to claim 52, further comprising a substantially transparent silicone, wherein the carbon dioxide indicator and aqueous pH indicator encapsulated within the silicone.

55. A sensor according to claim 52, further comprising a substantially transparent film enclosing the carbon and substantially transparent container, the housing gas permeable and charged-particle impermeable.

56. The package recited in Claim 52, wherein the carbon dioxide indicator comprises a substantially transparent agar and wherein the indicator is cured in a mixture with the agar.

57. A sensor for detecting a presence of bacteria in a perishable food product, the sensor comprising:

    a gas-permeable material having at least two opposing surfaces exposed for a gas diffusion therethrough; and

    a pH indicator carried by the gas-permeable material for detecting a change in a gaseous bacterial metabolite concentration indicative of bacterial growth, wherein a pH change results from the presence of the metabolite.

58. A sensor according to claim 57, further comprising a container dimensioned for receiving the perishable food product therein.

59. A sensor according to claim 57, wherein the pH indicator is responsive to an alkaline gas.

60. A sensor according to claim 59, wherein the alkaline gas comprises ammonia resulting from a protein breakdown of the food product.

61. A sensor according to claim 57, wherein the pH indicator is responsive to an acidic gas.

62. A sensor according to claim 61, wherein the acidic gas comprises carbon dioxide resulting from bacterial growth in the food product.

63. A sensor according to claim 57, wherein the gas permeable material and pH indicator are formed from an edible material.

64. A sensor according to claim 63, wherein the pH indicator is formed from a food extract.

65. A sensor according to claim 64, wherein the food extract is processed from a food group consisting of cabbage, grapes, onions, berries, flowers, plums, and cherries.

66. A sensor according to claim 64, wherein the pH indicator comprises at least one of glucose and sucrose for reducing a rate of oxidation and breakdown thereof.

67. A sensor according to claim 66, wherein the pH indicator changes color within a predetermined time period regardless of bacterial growth and freshness of the food product.

68. A method of detecting a presence of bacteria in a perishable food product comprising:

providing a container for receiving the food product therein;

placing the food product within the container;

providing a pH sensitive material including a pH indicator for providing a visual color change responsive to an increased level of carbon dioxide gas above an ambient level thereof; and

placing the pH sensitive material within the container, wherein at least two opposing surfaces of the pH sensitive material are in a spaced relation to the food product and walls of the container for permitting a free movement of the carbon dioxide gas thereabout and direct diffusion of the carbon dioxide gas onto and through the at least two opposing surfaces of the pH sensitive material.

69. The method according to claim 68, further comprising carrying the pH sensitive material by a housing.

70. The method according to claim 69, wherein the housing includes a bore extending therethrough, and wherein the pH sensitive material is carried therein.

71. The method according to claim 69, wherein the pH sensitive material placing comprises fastening the housing to at least one of the container and the food product.

72. The method according to claim 71, wherein the fastening comprises removably attaching the housing.

73. The method according to claim 68, further comprising:  
monitoring the pH sensitive material for the visual color change; and  
comparing a color resulting from the visual color change to a reference  
color.

74. The method according to claim 68, wherein a color change from  
green to orange results from the increased level of carbon dioxide gas  
diffusing through the pH sensitive material for reducing a hydrogen ion  
concentration and thus reducing the pH.

75. The method according to claim 68, wherein the pH sensitive  
material comprises a mixture of bromothymol blue and methyl orange.

76. The method according to claim 75, wherein a color change from  
green to orange results from the increased level of carbon dioxide gas  
diffusing through the pH sensitive material for reducing a hydrogen ion  
concentration and thus reducing the pH.

77. The method according to claim 76, further comprising:  
removing the pH sensitive material from the container;  
placing the pH sensitive material within another container; and  
placing another food product in the other container, wherein at  
least two opposing surfaces of the pH sensitive material are in a spaced  
relation to the food product and walls of the other container for permitting a  
free movement of the carbon dioxide gas thereabout and direct diffusion of the  
carbon dioxide gas onto and through the at least two opposing surfaces of the  
pH sensitive material.

78. A method of detecting a presence of bacteria in a perishable  
food product comprising:

providing a pH sensitive material having at least two opposing surfaces, the pH sensitive material including a pH indicator for providing a visual color change responsive to an increased level of carbon dioxide gas above an ambient level thereof; and

exposing the pH sensitive material to the increased level of carbon dioxide for permitting the gas to be diffused onto and through the at least two opposing surfaces.

79. The method according to claim 78, further comprising placing the at least two opposing surfaces of the pH sensitive material in a spaced relation to the food product for permitting a free movement of the carbon dioxide gas thereabout and direct diffusion of the carbon dioxide gas onto and through the at least two opposing surfaces of the pH sensitive material.

80. The method according to claim 78, further comprising placing the food product and the pH sensitive material in a container for detecting the increased gas within the container.

81. The method according to claim 80, further comprising carrying the pH sensitive material only within a lower one-half portion of the container.

82. The method according to claim 78, further comprising adding an agent to the pH sensitive material for preventing a freezing of any water component therein below 0°C.

83. The method according to claim 78, further comprising:  
adding a buffered pH indicator having a reference color indicative of an initial pH level as represented by an initial color;  
and wherein

the pH sensitive material includes the reference color at an initial pH level and changes to a warning color at a predetermined pH level, the warning color visually contrasting the reference color.

84. The method according to claim 78, further comprising:  
a reference color indicative of an initial pH level as represented by an initial color;  
and wherein

the pH sensitive material includes the reference color at a first predetermined pH level and changes to a warning color at a second predetermined pH level, the warning color visually contrasting the reference color.

85. The method according to claim 84, further comprising:  
providing a housing; and  
carrying the pH sensitive material and the reference color by the housing.

86. The method according to claim 85, wherein the housing carries a color representative of the reference color.

87. The method according to claim 85, wherein the housing carries a color representative of the warning color.

88. The method according to claim 85, wherein the housing carries a green color, and wherein a color change from the green color to an orange color results from the increased level of carbon dioxide gas.

89. A method for detecting a presence of bacteria in a perishable food product, the method comprising:  
carrying a pH indicator by a gas permeable material;

exposing at least two opposing surfaces of the material to a gaseous bacterial metabolite concentration indicative of bacterial growth in the perishable food product for diffusion of the gaseous bacterial metabolite therethrough; and

detecting a color change in the pH indicator resulting from the gaseous bacterial metabolite diffusion through the gas permeable material, wherein the change results from the presence of the metabolite.

90. A method according to claim 89, further comprising placing the gas-permeable material in a container having the food product carried therein.

91. A method according to claim 89, wherein the pH indicator is responsive to an alkaline gas.

92. A method according to claim 91, wherein the alkaline gas comprises ammonia resulting from a protein breakdown of the food product.

93. A method according to claim 89, wherein the pH indicator is responsive to an acidic gas.

94. A method according to claim 93, wherein the acidic gas comprises carbon dioxide resulting from bacterial growth in the food product.

95. A method according to claim 89, further comprising forming the gas permeable material and pH indicator from an edible material.

96. A method according to claim 95, wherein the pH indicator forming comprises processing a food extract.

97. A method according to claim 96, wherein the processing includes selecting from a food group consisting of cabbage, grapes, onions, berries, flowers, plums, and cherries.

98. A method according to claim 96, further comprising mixing at least one of glucose and sucrose with the pH indicator for reducing a rate of oxidation and breakdown thereof.

99. A method according to claim 98, wherein the pH indicator changes color within a predetermined time period regardless of bacterial growth and freshness of the food product.